

Feasibility of a Combined Percutaneous Laparoscopic Three-Millimeter Device

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ABSTRACT

Background and Objectives: Needlescopic 3-mm instruments induce minimal trauma and produce excellent cosmetic results. A combination of a 3-mm abdominal wall incision and a 5-mm instrument in the abdominal cavity would combine the beneficial features of these two different sizes.

Methods: The Percutaneous Surgical System (PSS) (Ethicon EndoSurgery, Galway, Ireland) is a new instrument consisting of a 3-mm shaft that is introduced percutaneously into the abdominal cavity. Through a 5-mm trocar, a loader with a 5-mm attachment such as a Maryland dissector is introduced. The attachment is connected to the shaft, and the loader is removed from the abdomen. The feasibility of this device was evaluated retrospectively in 3 Swedish hospitals between January and September 2012.

Results: Twenty-eight patients were laparoscopically operated on (cholecystectomy, gastric bypass, fundoplication, incisional hernias, and totally extraperitoneal repair for inguinal hernia) by use of 1 or 2 PSSs in each operation (47 in total). It was feasible to use the PSS in all procedures except during the totally extraperitoneal repair procedure because of the limited available preperitoneal space. Especially in laparoscopic cholecystectomies, the two lateral 5-mm trocars were easily replaced by two 3-mm PSS instruments.

Conclusions: The use of the PSS is feasible in a number of laparoscopic procedures, where it can replace 5-mm

trocars. Randomized controlled trials are needed to determine the future role of the PSS versus, for example, needlescopic laparoscopy.

Key Words: Laparoscopy, Needlescopic, Percutaneous, Device.

INTRODUCTION

Needlescopic instruments ([me]3 mm) have been used for various laparoscopic procedures for the past 35 years.^{1–3} A smaller incision induces less trauma and pain and gives a better cosmetic result as compared with standard incisions.¹ However, 2- or 3-mm instruments are weaker with smaller jaws than a 5-mm instrument, and they are also not as blunt. This may be the reason that some authors report conversions to conventional 5-mm laparoscopy during needlescopic procedures, as well as a comparatively longer operation time.⁴ A smaller incision would probably decrease the risk of trocar hernias.

A combination of a 3-mm abdominal wall incision and a 5-mm instrument in the abdominal cavity would combine the beneficial features of these two different sizes. The aim of this study was to investigate whether the use of such an instrument is feasible in various laparoscopic procedures.

MATERIALS AND METHODS

The Percutaneous Surgical System (PSS) (Ethicon EndoSurgery, Galway, Ireland) was used in all cases. This is a disposable instrument that consists of 3 parts. One is a 3-mm shaft with a sharp retractable tip that is inserted directly through the abdominal wall through a small skin incision (**Figures 1–3**). The sharp tip is retracted (**Figure 4**). The second part is a 5-mm loader that is inserted through a standard 5-mm trocar (**Figures 4–6**). This loader carries a 5-mm attachment. The attachment comes in two different variations. One is a Maryland dissector, and the other is a blunt grasper that is connected to the 3-mm shaft (**Figures 7–9**). The loader is disconnected from the attachment and is removed from the abdominal cavity (**Figures 10–12**). The result is a 5-mm instrument attached on a 3-mm percutaneous shaft (**Figures 12–14**).

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The authors are grateful to Hanna Bringman (www.bringman.se) for the illustrations.

The devices were paid for by the hospitals with a discount.

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DOI: 10.4293/108680813X13693422520161

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Figure 1. A 3-mm shaft with a sharp retractable tip is inserted directly through the abdominal wall through a small skin incision.

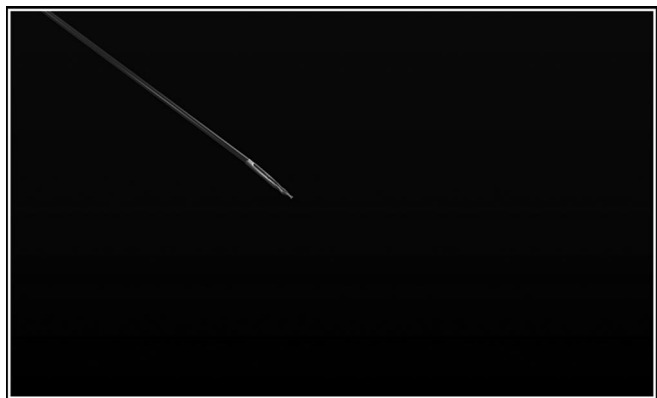


Figure 2. Close-up of Figure 1.



Figure 3. Three-millimeter instrument with sharp retractable tip.

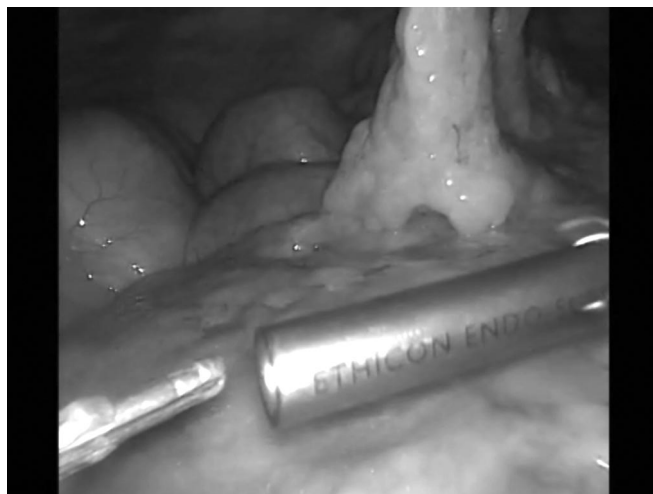


Figure 4. Blunt tip and loader.



Figure 5. A 5-mm loader is inserted through a standard 5-mm trocar. It carries a 5-mm Maryland grasper attachment, which is either a Maryland dissector or a blunt grasper.

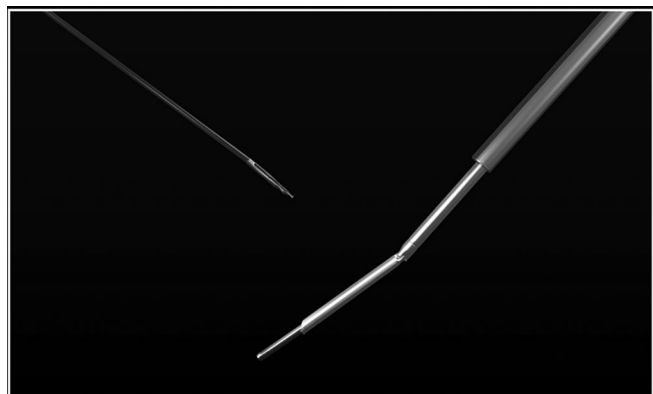


Figure 6. Close-up of Figure 5.

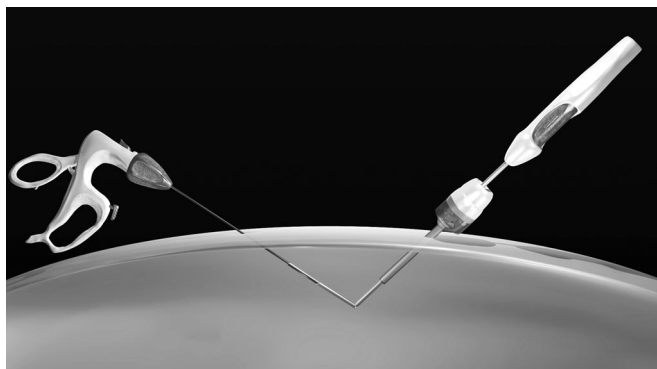


Figure 7. The Maryland dissector attachment is connected to the 3-mm shaft.

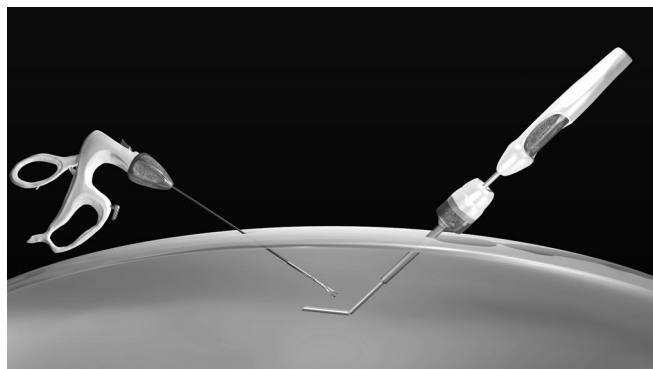


Figure 10. The loader is disconnected from the Maryland dissector attachment.

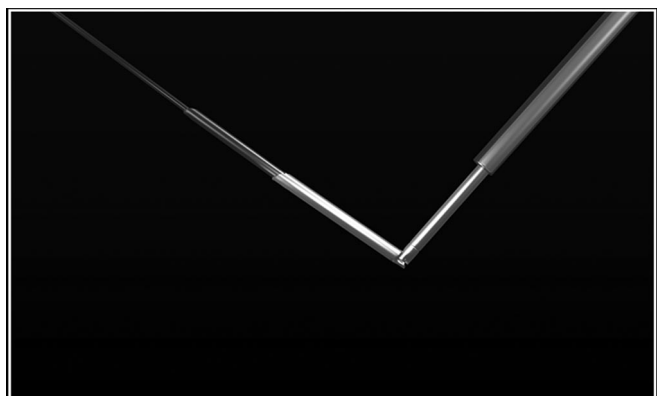


Figure 8. Close-up of Figure 7.

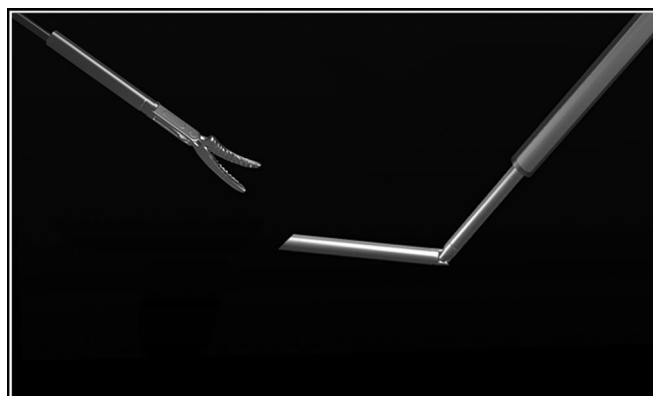


Figure 11. Close-up of Figure 10.



Figure 9. Connection between loader with Maryland grasper attachment and 3-mm shaft.



Figure 12. The loader is disconnected from the Maryland grasper attachment.



Figure 13. The loader is removed from the abdominal cavity, and the result is a 5-mm instrument attached on a 3-mm percutaneous shaft.



Figure 14. Close-up of Figure 13.

When the 5-mm instrument is removed from the 3-mm shaft, the loader is introduced in the abdominal cavity again through a 5-mm trocar. It is connected to the 5-mm instrument and disconnects it from the 3-mm shaft. The loader carries the 5-mm attachment out of the abdominal cavity. Finally, the 3-mm shaft is removed from the abdominal cavity.

Three senior laparoscopic surgeons in 3 Swedish general hospitals used the PSS between January and September 2012, and the results were evaluated retrospectively.

RESULTS

In total, 28 patients (18 female and 10 male patients) with a median age of 46 years (range, 17–71 years) were laparoscopically operated on with one or two PSSs in

each operation (23 blunt and 24 dissectors in total). The distribution of the operations is described in **Table 1**. The median body mass index was 28 (range, 22–50).

The median operation time was 55 minutes (range, 17–127 minutes), and there were no complications related to the instrument. Fourteen patients were operated on as day-surgery cases, and the rest had a median hospital stay of 1 day (range, 1–2 days).

One gastric bypass patient had a postoperative abdominal wall hematoma around a 12-mm trocar incision.

It was feasible to use the PSS in all procedures except in the totally extraperitoneal repair (TEP) procedure, in which the preperitoneal space was too small. In all laparoscopic cholecystectomies, the two lateral trocars could readily be replaced with the PSS, also including one case of trans cystic common bile duct stone extraction. The specimens were extracted through a 12-mm trocar. In laparoscopic intraperitoneal onlay mesh for incisional hernias, the PSS could be replaced through a number of incisions for adhesiolysis from various angles. It was possible to use the device for suturing in gastric bypass and in Nissen fundoplication, as well as to replace one of the lateral trocars in some cases.

To learn how to assemble and disassemble the instrument, there is a model to practice on. We practiced about 10 times before surgery. The time to introduce and assemble the instrument is 30 to 60 seconds. If the attachment falls off while assembling and disassembling, it is easy to pick the attachment up with another instrument and connect it to the loader again. This occurred in two operations. There was no loss of instrument parts in the abdominal cavities during the study.

DISCUSSION

This study supports that the use of a 3-mm percutaneous instrument is feasible in a number of laparoscopic procedures.

Table 1. Distribution of Laparoscopic Operations	
	No. of Patients
Cholecystectomy	14
Incisional hernia	5
Gastric bypass	4
Fundoplication	4
TEP	1

The number and variability of the procedures do not allow any analysis of postoperative pain or cosmetic results, but it is obvious that a smaller incision gives a smaller scar.

The greatest benefit in our experience was to use the PSS in laparoscopic cholecystectomies in which the two sub-costal trocars could effortlessly be replaced with a PSS with complete adherence to routine safety measures and the performance of routine perioperative cholangiography. Furthermore, transcystic common bile duct stone extraction was performed in one of the procedures without any drawbacks of the PSS instruments.

One advantage of the PSS is the possibility to replace the instrument in many locations because the abdominal wall trauma is so small.

In the TEP procedure, the available space was too small to use the PSS. The distance in the abdominal wall between the 3-mm shaft and the loader with the attachment needs to be larger than the distance it is possible to achieve in a TEP procedure.

A disadvantage of the PSS is that it takes time to introduce and assemble the device and to disassemble and remove it as well. This takes longer than just introducing a 5-mm trocar and a 5-mm instrument.

At present, only two different attachments are available to connect to the PSS. Both are too traumatic for bowel grasping, which limits the possibility of using the PSS as a replacement for other instruments in gastric bypass and colorectal procedures where the bowel is grasped. An attachment with an atraumatic dissector would be an instrument with potential in this field of surgery.

In conclusion, the PSS was feasible to use in different laparoscopic procedures. To be able to decide which role it should have in the future, randomized controlled trials comparing it with, for example, needlescopic laparoscopy are needed.

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